

Physico-Chemical Characteristics of Ground Water Quality in and around Oil Refinery near by Nagpur City in India

Dr. D.G. Battalwar and Hitendra Dhargave
Department HOD, GYAN ENVIRO, Nagpur, India

Abstract: This paper is intended to be a study concerning ground water quality at Refinery in Nagpur city, Maharashtra. Regional and seasonal variation of some physico-chemical parameters such as nutrients salts, total phosphorus, in addition, temperature, pH, conductivity, dissolved oxygen, chemical oxygen (COD), Biological oxygen demand (BOD) and suspended solids (SS) were determined for the estimation of pollution load during January to December 2011. The sampling points were selected on the basis of their importance. A monitoring network was set at representative site in the whole studied area and water samples were taken regular basis for laboratory analysis. Important variations have occurred in the investigated area as a result of oil refinery works and discharge of waste water. All the calculated ground water quality parameters in studied lakes showed fair water quality rating in autumn season which then change to medium in winter seasons and higher during rainy seasons. The situation is alarming and degradation is in continues process, therefore immediate action is required for its better management.

Keywords: ground water quality; pollution; physico-chemical; management

I. INTRODUCTION

Analysis of ground water and surface water is becoming increasingly important in order to monitor the ground water quality. This activity also forms a pre-requisite for treatability studies or to assess the health effects. The oil refineries located in Khapri village, Wardha Road, Nagpur is supplying petroleum fuels to retail outlets and bulk consumers like Railways, Electricity Boards, and Power Industries etc. in Vidharbha region of Maharashtra. The products are received through (road and/or rail and/or pipeline and/or sea tanker etc.) Mode of transportation and dispatched to the end consumers through road¹.

This oil refineries were functional since 1983 is operated in accordance with the provisions of licenses/consents granted by the Chief Controller of Explosive, Govt. of India, Chief Factory Inspector, Maharashtra and Maharashtra State Pollution Control Board as per the relevant statutory Acts and Rules of Govt. of India and Maharashtra. The installation has been designed, operated and maintained in accordance with the statutory provisions and industry standards to ensure its safe and smooth functioning.²

The oil refineries have storage facility of petroleum products like Motor Spirit, Kerosene, High Speed Diesel, Furnace Oil and Light Diesel Oil.

In order to assess the present ground water quality of the core zone of oil refineries water quality were collected during period of January 2011 to December 2011 nearby core of radius 3Km from the oil refineries and analyzed for selected environmental parameters viz Physical, Chemical and heavy metals.³

This 'Ground water quality monitoring' report has been prepared on basis of data collected during sample collection in & around various oil refineries at Khapri, Dist, Nagpur.). This report is representing the current environmental status regarding Ground Water Quality in & around the oil refineries.

II. MATERIALS AND METHODS

GROUND WATER QUALITY: A routine analysis of Water Quality is required to find out any contamination of natural water source. The bottling plant is maintaining the '**Zero Discharge**' condition and Ponds are lined. There is no chance of ground water contamination. However, as per stipulated condition, ground water quality have monitored for routine parameters.⁴

Water Sample Collection: ground water samples were collected in polyethylene container at the points where stream flow measurement was taken. The water sample for analysis was collected at each sampling station and subsequently stream flow was measured. The samples for phytoplankton analysis were collected in the same site by filtering 25 liter of water in bolting silk net No.25. In the case of tributaries, the flow measurement and water quality samples were taken immediately the tributary confluence in to reservoir at monthly basis. The water samples were stored in 4° C.

Biological analysis: Changes in water quality exert a selective action on the flora and fauna, which constitute the living population of water, and the effects produced in them can be used to establish biological indices of water quality. Biological methods used for assessing the water quality includes the collection, counting, and identification of the aquatic organisms.⁵

Coliform test: This method is intended to indicate the degree of contamination of water with wastes. The water may serve as a vehicle for the transmission of waterborne diseases. Polluted water contains vast amounts of organic matter that serve as an excellent nutrient source for the growth and multiplication of the microorganisms. The presence of non-pathogenic organisms is not of major concern, but intestinal contaminants of faecal origin are important. Analysis of water samples on a routine basis would not be possible if each pathogen required to detection. Therefore, water is examined to detect *Escherichia coli*, the bacterium that indicates the faecal pollution. Since *Escherichia coli* is always present in faeces and whose normal habitat is the intestine of humans and other higher animals. *Escherichia coli*, the Gram negative, non-spore forming bacilli that ferment lactose with the produce H₂S gas. The medium contains Ferrous ammonium citrate, which reacts with the H₂S and turns in to black colour within 48 hours. **Medium composition:** Peptone, Dipotassium hydrogen phosphate, Ferric ammonium citrate, sodium thiosulphate, 1ml Teepol and 50 ml distilled water⁶

Experimental

During the course of analysis /experiential work, all the glassware’s used were cleaned thoroughly with tap water, chromic acid (cleaning reagent) and finally rinsed with distilled water. The chemicals and reagents used for analysis work were of Analytical Grade (AR) /Guaranteed Grade (GR).

A) Materials

1. Glassware’s: All the glassware’s that were used of CORNING/BOROSIL make.
2. Instruments/Equipment’s

The instruments and equipment’s used for the study in **Table 1**

Table 1: List of Equipment’s and Glassware’s

S. N	Name of Instruments	Make	Measurement sensitivity
1	Atomic Absorption Spectrophotometer Model-AA-6300	Shimadzu	±0.001ppm
2	Magnetic Stirrer	Remi	1 MLH
3	Monopan Balance	K-Roy	0.1 mg
4	UV-Visible Spectrophotometer Elico – 210 Model with all accessories	Elico	±0.01ppm
5	PH Meter	E-Tech	±
6	Conductivity Meter	Systronics	1000 to 200,000 µS/cm
7	Nephelometer	Chemito	--

Location Of Water Quality Sampling

Sampling is that part of statistical practice concerned with the selection of individual observations intended to yield some

knowledge about a population of concern; especially for the purposes of statistical inference. Each observation measures one or more properties of an observable entity enumerated to distinguish objects or individuals The water quality monitoring was selected with a view to check out the impact on ground water sources in and around i.e., 3km core zone radius of oil refineries. A total number of 10 (Ten) ground water samples (nearby the oil refineries, were collected and analyzed. Analysis of ground water quality was done as per Indian Standard 10500:1991.⁷

Location of sampling stations is given in **Table – 2 and Fig.1**

Table – 2: Descriptive Listing of Ground Water Sampling Stations

Sr. No.	Sampling Stations	Station Code	Distance from Refinery	Direction from Refinery
1	Open Dug well at Khapri Village	GW – 1	2.8 km	W
2	Bore well water at Khapri Village	GW – 2	2.6 km	SW
3	Bore Well ar Gram Panchayat, Khapri Village	GW – 3	1.1 km	S
4	Bore Well water at Khapri Village	GW – 4	0.8 km	SE
5	Bore Well water at Swami Vivekand Hospital, Khapri Village	GW – 5	0.3 km	SE
6	Bore Well water at Panjri Village	GW- 6	3.1 km	SE
7	Bore Well water at Panjri Village	GW – 7	2.9 km	SE
8	Tube Well water at Gram Panchayat, Panjri	GW – 8	2.5 km	SE
9	Bore Well water at Panjri Village	GW – 9	2.0 km	SE
10	Bore Well water at Panjri Village	GW – 10	1.8 km	NE



Fig 1: Location map for ground water sample collection

Observation:

The Ground water samples were collected in & around various oil refineries at Khapri, Dist, Nagpur during the period

of January 2011 to December 2011. Ground water samples were analyzed by the Standard methods (IS: 10500:1991)

in tabular form. The ground water quality in and around oil refineries were shown in **Table 3 to Table 7**.

This report is representing the current environmental status regarding Ground Water Quality in & around the oil refineries

Table 3: Ground Water Quality – January 2011 to December 2011

S. N	Parameters	Unit	As per IS 10500:1991		Values	
			Desirable	Permissible	GW-1	GW-2
1.	Color	Hazen	5	25	<1	<1
2.	Odour	UO	UO	UO	UO	UO
3.	Taste	AG	AG	AG	AG	AG
4.	Turbidity	NTU	5	10	0	0
5.	Total Dissolved Solids	mg/l	500	2000	1300	1680
6.	pH at 25 °C		6.5 – 8.5	NR	7.26	7.08
7.	Dissolved Oxygen (DO)	mg/l	-	-	4.2	4.3
8.	BOD (3 Days at 27°C)	mg/l	-	-	<5	<5
9.	COD	mg/l	-	-	4	12
10.	Conductivity	µS/cm	-	-	203	821
11.	Total Alkalinity as CaCO ₃	mg/l	200	600	145	148
12.	Total Hardness as CaCO ₃	mg/l	300	600	157	168
13.	Calcium as Ca ⁺⁺	mg/l	75	200	45.1	46.5
15.	Chlorides as Cl ⁻	mg/l	250	1000	110	224
16.	Sulphates as SO ₄ ⁻	mg/l	200	400	163	163
17.	Fluoride as F ⁻	mg/l	1.0	1.5	0.58	0.59
18.	Nitrates as NO ₃ ⁻	mg/l	45	NR	13.1	14.12
19.	Iron as Fe	mg/l	0.3	1.0	0.071	0.097
20.	Manganese as Mn	mg/l	0.1	0.3	<0.01	<0.01
21.	Zinc as Zn	mg/l	5.0	15.0	0.207	0.841
22.	Copper as Cu	mg/l	0.05	1.5	0.014	0.012
23.	Aluminum as Al	mg/l	0.03	0.2	<0.01	<0.01
24.	Boron as B	mg/l	1.0	5.0	<0.01	<0.01
25.	Total Coliform	MPN/ 100 ml	Absent	NR	0.0	0.0
26.	E. Coli	MPN/ 100 ml	Absent	NR	0.0	0.0
27.	Oil & Grease	mg/l	NR	0.3	0.18	0.12
TOXIC SUBSTANCES						
28.	Cadmium as Cd	mg/l	0.01	NR	< 0.005	< 0.005
29.	Arsenic as As	mg/l	0.01	NR	< 0.005	< 0.005
30.	Lead as Pb	mg/l	0.05	NR	< 0.001	< 0.001
31.	Chromium Cr	mg/l	0.05	NR	< 0.01	< 0.01
32.	Mercury as Hg	mg/l	0.001	NR	< 0.001	< 0.001

Table 4: Ground Water Quality – January 2011-December 2011

S.N.	Parameters	Unit	As per IS 10500:1991		Values	
			Desirable	Permissible	GW-3	GW-4
1.	Color	Hazen	5	25	<1	2
2.	Odour	UO	UO	UO	UO	UO
3.	Taste	AG	AG	AG	AG	AG
4.	Turbidity	NTU	5	10	0	4
5.	Total Dissolved Solids	mg/l	500	2000	1060	1150
6.	pH at 25 °C		6.5 – 8.5	NR	7.2	7.12
7.	Dissolved Oxygen (DO)	mg/l	-	-	4.2	4.2
8.	BOD (3 Days at 27°C)	mg/l	-	-	<5	<5
9.	COD	mg/l	-	-	12	12
10.	Conductivity	µS/cm	-	-	161	110
11.	Total Alkalinity as CaCO ₃	mg/l	200	600	142	144
12.	Total Hardness as CaCO ₃	mg/l	300	600	145	154
13.	Calcium as Ca ⁺⁺	mg/l	75	200	44.8	45
15.	Chlorides as Cl ⁻	mg/l	250	1000	87	82
16.	Sulphates as SO ₄ ⁻	mg/l	200	400	168	120
17.	Fluoride as F ⁻	mg/l	1.0	1.5	0.21	0.31
18.	Nitrates as NO ₃ ⁻	mg/l	45	NR	9.11	12.0
19.	Iron as Fe	mg/l	0.3	1.0	0.076	0.068
20.	Manganese as Mn	mg/l	0.1	0.3	<0.01	<0.01
21.	Zinc as Zn	mg/l	5.0	15.0	0.128	2.158
22.	Copper as Cu	mg/l	0.05	1.5	0.01	0.006
23.	Aluminum as Al	mg/l	0.03	0.2	<0.01	<0.01
24.	Boron as B	mg/l	1.0	5.0	<0.01	<0.01
25.	Total Coliform	MPN/ 100 ml	Absent	NR	0.0	1.0
26.	E. Coli	MPN/ 100 ml	Absent	NR	0.0	0.0
27.	Oil & Grease	Mg/l	NR	0.3	0.2	0.12
TOXIC SUBSTANCES						
28.	Cadmium as Cd	mg/l	0.01	NR	< 0.005	< 0.005
29.	Arsenic as As	mg/l	0.01	NR	< 0.005	< 0.005
30.	Lead as Pb	mg/l	0.05	NR	< 0.001	< 0.001
31.	Chromium Cr	mg/l	0.05	NR	< 0.01	< 0.01
32.	Mercury as Hg	mg/l	0.001	NR	< 0.001	< 0.001

Table 5: Ground Water Quality – January 2011 to December 2011

S.N.	Parameters	Unit	As per IS 10500:1991		Values	
			Desirable	Permissible	GW-5	GW-6
1.	Color	Hazen	5	25	<1	2
2.	Odour	UO	UO	UO	UO	UO
3.	Taste	AG	AG	AG	AG	AG
4.	Turbidity	NTU	5	10	0	7
5.	Total Dissolved Solids	mg/l	500	2000	1030	1350

6.	pH at 25 °C		6.5 – 8.5	NR	7.6	7.4
7.	Dissolved Oxygen (DO)	mg/l	-	-	4.5	4.5
8.	BOD(3 Days at 27°C)	mg/l	-	-	<5	<5
9.	COD	mg/l	-	-	8	8
10.	Conductivity	µS/cm	-	-	301	410
11.	Total Alkalinity as CaCO ₃	mg/l	200	600	117	380
12.	Total Hardness as CaCO ₃	mg/l	300	600	118	254
13.	Calcium as Ca ⁺⁺	mg/l	75	200	39.2	68.2
15.	Chlorides as Cl ⁻	mg/l	250	1000	235	132
16.	Sulphates as SO ₄ ⁻	mg/l	200	400	120	122
17.	Fluoride as F ⁻	mg/l	1.0	1.5	0.19	0.51
18.	Nitrates as NO ₃ ⁻	mg/l	45	NR	7.84	13.1
19.	Iron as Fe	mg/l	0.3	1.0	0.21	0.208
20.	Manganese as Mn	mg/l	0.1	0.3	<0.01	<0.01
21.	Zinc as Zn	mg/l	5.0	15.0	0.178	0.259
22.	Copper as Cu	mg/l	0.05	1.5	0.016	0.009
23.	Aluminum as Al	mg/l	0.03	0.2	<0.01	<0.01
24.	Boron as B	mg/l	1.0	5.0	<0.01	<0.01
25.	Total Coliform	MPN/ 100 ml	Absent	NR	0.0	0.0
26.	E. Coli	MPN/ 100 ml	Absent	NR	0.0	0.0
27.	Oil & Grease	Mg/l	NR	0.3	0.14	0.11
TOXIC SUBSTANCES						
28.	Cadmium as Cd	mg/l	0.01	NR	< 0.005	< 0.005
29.	Arsenic as As	mg/l	0.01	NR	< 0.005	< 0.005
30.	Lead as Pb	mg/l	0.05	NR	< 0.001	< 0.001
31.	Chromium Cr	mg/l	0.05	NR	< 0.01	< 0.01
32.	Mercury as Hg	mg/l	0.001	NR	< 0.001	< 0.001

Table 6: Ground Water Quality – January 2011 to December 2011

S.N	Parameters	Unit	As per IS 10500:1991		Values	
			Desirable	Permissible	GW-7	GW-8
1.	Color	Hazen	5	25	3	<1
2.	Odour	UO	UO	UO	UO	UO
3.	Taste	AG	AG	AG	AG	AG
4.	Turbidity	NTU	5	10	8	0
5.	Total Dissolved Solids	mg/l	500	2000	1870	1150
6.	pH at 25 °C		6.5 – 8.5	NR	7.3	7.6
7.	Dissolved Oxygen (DO)	mg/l	-	-	4.4	4.6
8.	BOD (3 Days at 27°C)	mg/l	-	-	<5	<5
9.	COD	mg/l	-	-	8	12
10.	Conductivity	µS/cm	-	-	942	210
11.	Total Alkalinity as CaCO ₃	mg/l	200	600	460	220
12.	Total Hardness as CaCO ₃	mg/l	300	600	288	258
13.	Calcium as Ca ⁺⁺	mg/l	75	200	72.4	68.6

15.	Chlorides as Cl ⁻	mg/l	250	1000	237	132
16.	Sulphates as SO ₄ ⁻	mg/l	200	400	162	162
17.	Fluoride as F ⁻	mg/l	1.0	1.5	0.62	0.31
18.	Nitrates as NO ₃ ⁻	mg/l	45	NR	16.1	9.1
19.	Iron as Fe	mg/l	0.3	1.0	0.185	0.083
20.	Manganese as Mn	mg/l	0.1	0.3	<0.01	<0.01
21.	Zinc as Zn	mg/l	5.0	15.0	0.908	0.129
22.	Copper as Cu	mg/l	0.05	1.5	0.017	0.003
23.	Aluminum as Al	mg/l	0.03	0.2	<0.01	<0.01
24.	Boron as B	mg/l	1.0	5.0	<0.01	<0.01
25.	Total Coliform	MPN/100ml	Absent	NR	0.0	0.0
26.	E. Coli	MPN/100ml	Absent	NR	0.0	0.0
27.	Oil & Grease	Mg/l	NR	0.3	0.13	0.14
TOXIC SUBSTANCES						
28.	Cadmium as Cd	mg/l	0.01	NR	< 0.005	< 0.005
29.	Arsenic as As	mg/l	0.01	NR	< 0.005	< 0.005
30.	Lead as Pb	mg/l	0.05	NR	< 0.001	< 0.001
31.	Chromium Cr	mg/l	0.05	NR	< 0.01	< 0.01
32.	Mercury as Hg	mg/l	0.001	NR	< 0.001	< 0.001

Table 7: Ground Water Quality – January 2011 to December 2011

S.N	Parameters	Unit	As per IS 10500:1991		Values	
			Desirable	Permissible	GW-9	GW-10
1.	Color	Hazen	5	25	2	<1
2.	Odour	UO	UO	UO	UO	UO
3.	Taste	AG	AG	AG	AG	AG
4.	Turbidity	NTU	5	10	0	2
5.	Total Dissolved Solids	mg/l	500	2000	1260	780
6.	pH at 25 °C		6.5 – 8.5	NR	8.1	8.4
7.	Dissolved Oxygen (DO)	mg/l	-	-	4.5	4.4
8.	BOD (3 Days at 27°C)	mg/l	-	-	<5	<5
9.	COD	mg/l	-	-	12	8
10.	Conductivity	µS/cm	-	-	304	182
11.	Total Alkalinity as CaCO ₃	mg/l	200	600	330	120
12.	Total Hardness as CaCO ₃	mg/l	300	600	112	50
13.	Calcium as Ca ⁺⁺	mg/l	75	200	41.3	13.5
15.	Chlorides as Cl ⁻	mg/l	250	1000	164	206
16.	Sulphates as SO ₄ ⁻	mg/l	200	400	185	184
17.	Fluoride as F ⁻	mg/l	1.0	1.5	0.37	0.11
18.	Nitrates as NO ₃ ⁻	mg/l	45	NR	12.7	7.81
19.	Iron as Fe	mg/l	0.3	1.0	0.073	0.159
20.	Manganese as Mn	mg/l	0.1	0.3	<0.01	<0.01
21.	Zinc as Zn	mg/l	5.0	15.0	0.009	0.062
22.	Copper as Cu	mg/l	0.05	1.5	0.01	0.014
23.	Aluminum as Al	mg/l	0.03	0.2	<0.01	<0.01

24.	Boron as B	mg/l	1.0	5.0	<0.01	<0.01
25.	Total Coliform	MPN/100ml	Absent	NR	1.0	0.0
26.	E. Coli	MPN/100ml	Absent	NR	0.0	0.0
27.	Oil & Grease	Mg/l	NR	0.3	0.10	0.08
TOXIC SUBSTANCES						
28.	Cadmium as Cd	mg/l	0.01	NR	< 0.005	< 0.005
29.	Arsenic as As	mg/l	0.01	NR	< 0.005	< 0.005
30.	Lead as Pb	mg/l	0.05	NR	< 0.001	< 0.001
31.	Chromium Cr	mg/l	0.05	NR	< 0.01	< 0.01

The observation Table 3 to Table 7 was shows ground water quality for various borewell samples in and around oil refineries nearby Nagpur City. The graphical presentation for various parameters viz PH, TDS, Chloride, Sulphate, Total Hardness, Fluoride, Nitrate, Iron as Fe and Oil & grease observed value versus with International Standards IS:10500:-1991 in Fig 3 to Fig 11.

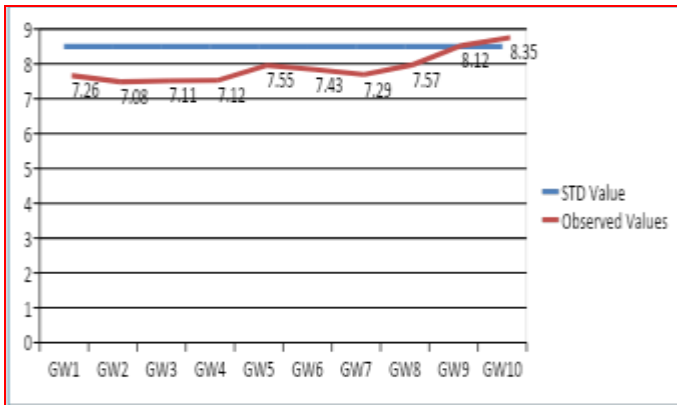


Fig 3: Graphical Representation for PH

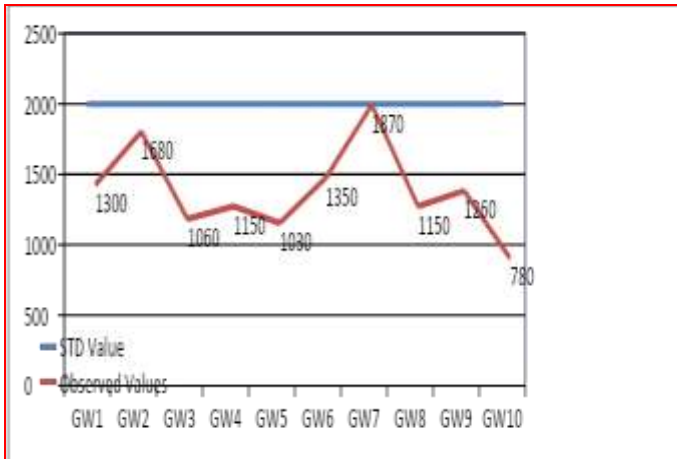


Fig 4: Graphical Representation for Total Dissolved Solids (TDS)

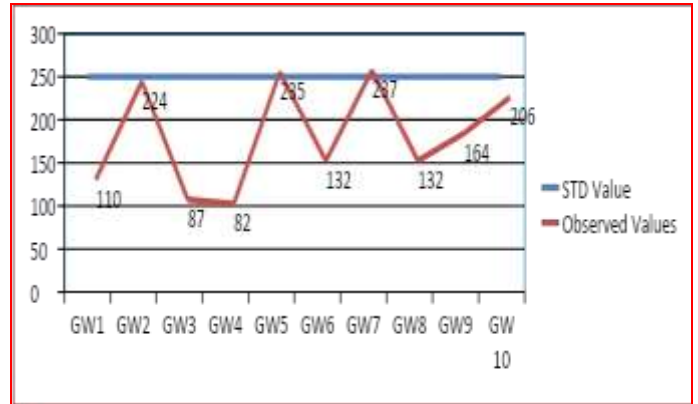


Fig 5: Graphical Representation for Chloride (Cl⁻)

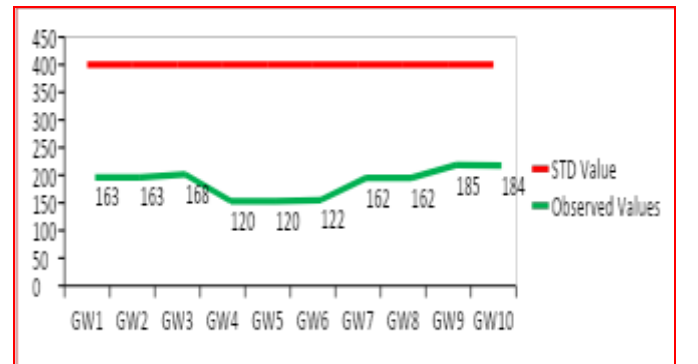


Fig 6: Graphical Representation for Sulphate (SO₄²⁻)

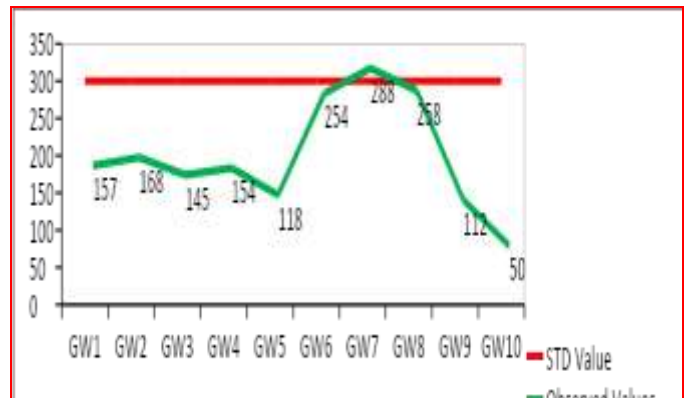


Fig 7: Graphical Representation for Total Hardness

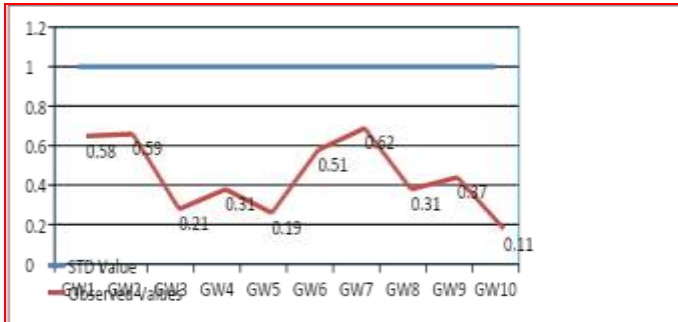


Fig 8: Graphical Representation for Fluoride (F1)

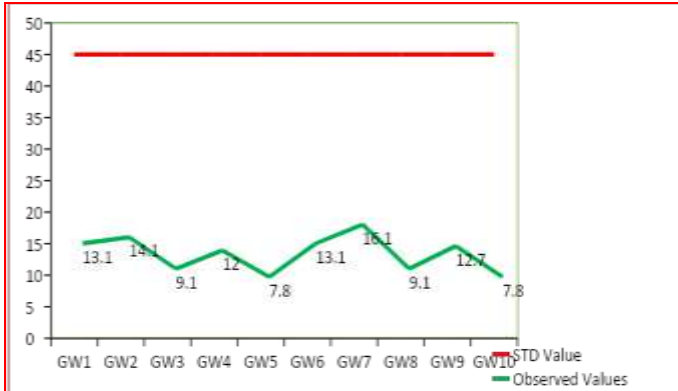


Fig 9: Graphical Representation for Nitrate (NO₃-)

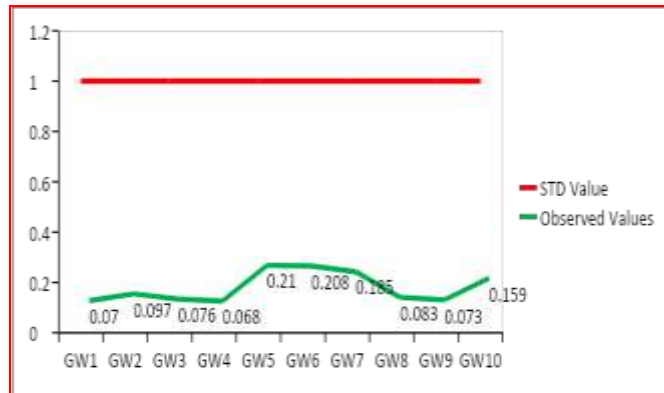


Fig 10: Graphical Representation for Iron (Fe)

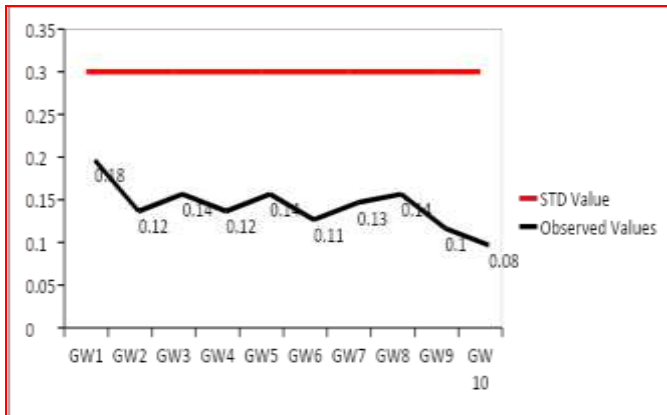


Fig 11: Graphical Representation for Oil & Grease (O&G)

III. RESULT AND DISCUSSION

The results of ground water analysis are discussed as per findings and its significance over environment and human being. Water quality & certain common characteristics have been described in following paragraphs.⁸

Chemical Parameters

A. COLOUR, ODOUR AND TASTE

Presence of these parameters gives some hints regarding source of water sample. These parameters are checked at site with help of relevant sense-organs.

All ten ground water samples (GW – 1, GW – 2 GW-3, GW-4, GW-5, GW-6, GW-7.GW-8, GW-9 and GW-10) are colorless in appearance.

All ten ground water samples (GW – 1, GW – 2 GW-3, GW-4, GW-5, GW-6, GW-7.GW-8, GW-9 and GW-10) collected for Odor test have represented no any objectionable odour.

Any salty or metallic taste in water samples comes only if salts or metals are present in high concentration. Here, all ten ground water samples (GW – 1, GW – 2 GW-3, GW-4, GW-5, GW-6, GW-7.GW-8, GW-9 and GW-10) have agreeable taste.

B. pH VALUE

pH is an important parameter, for drinking purpose it indicates the water is going to affect the mucous membrane and/or water supply system and for non-drinking purpose it indicates the contamination if the values are beyond the given range.

All ten ground water samples (GW – 1, GW – 2 GW-3, GW-4, GW-5, GW-6, GW-7.GW-8, GW-9 and GW-10) have pH 7.26, 7.08, 7.11, 7.12, 7.55, 7.43, 7.29, 7.57, 8.12 and 8.35 respectively. These values are within desirable range of 6.5 to 8.5 as per IS 10500:1991 standards for drinking water.

C. DISSOLVED OXYGEN

The dissolved Oxygen is main indicator of healthiness or otherwise of aquatic conditions, particularly for surface waters. It is very essential for survival of biological life in aquatic conditions.

All the ground water samples have DO as range of 4.2 to 4.5 mg/l respectively. Low DO value is quite natural for ground waters, which are not in much exposure with air environment.

D. BIOCHEMICAL OXYGEN DEMAND (BOD)

BOD indicates the oxygen requirement for stabilization of organic matter or pollution load in terms of biodegradable organic matter.

All ten ground water samples (GW – 1, GW – 2 GW-3, GW-4, GW-5, GW-6, GW-7.GW-8, GW-9 and GW-10) have BOD values less than 5.0 mg/l respectively. All samples are indicating very low organic pollution load and all BOD values are within the prescribed limit (< 30.0 mg/l) as in IS 2490:1982.

E. CHEMICAL OXYGEN DEMAND (COD)

It indicates 98% oxidizable matter like sulphides, ferrous ions, phenolic compounds, nitrates, ammonia, hexane extractable matter etc.

All ten ground water samples (GW – 1, GW – 2 GW-3, GW-4, GW-5, GW-6, GW-7.GW-8, GW-9 and GW-10) have COD values ranges 4.0 to 12.0 mg/l respectively. All water samples are indicating very low organic pollution load in terms of COD and all COD values are within the prescribed limit (< 250.0 mg/l) as in IS 2490:1982.⁹

F. DISSOLVED SOLIDS

Dissolved Solids may cause gastro intestinal irritation if water is being used for drinking purposes and its concentration is out of norms. There is no abnormality have found in water sample regarding dissolved solids concentrations.

All ten ground water samples (GW – 1, GW – 2 GW-3, GW-4, GW-5, GW-6, GW-7.GW-8, GW-9 and GW-10) have Dissolved Solids ranges from 780.0 to 1680.0 mg/l respectively, which are well below prescribed limit of 2000 mg/l as given in IS 10500:1991

G. CHLORIDES

Corrosion & palatability nature of water are affected if the Chlorides values are beyond the prescribed limits. All ten ground water samples (GW – 1, GW – 2 GW-3, GW-4, GW-5, GW-6, GW-7.GW-8, GW-9 and GW-10) have Chlorides concentrations ranges 82.0 to 224.0 mg/l respectively and well below the desirable limit of 250 mg/l as prescribed in IS 10500:1991

H. SULPHATES

High values of Sulphates may cause gastro intestinal irritation with Magnesium & Sodium. All ten ground water samples (GW – 1, GW – 2 GW-3, GW-4, GW-5, GW-6, GW-7.GW-8, GW-9 and GW-10) have Sulphate concentration 163.0,163.0,168.0,120.0,120.0,122.0,162.0,162.0,185.0 and 184.0 mg/l respectively against desirable limit of 200 mg/l as prescribed in IS 10500:1991

Total Hardness

Hardness causes encrustation in water supply structure in case of high values of water samples.

All ten ground water samples (GW – 1, GW – 2 GW-3, GW-4, GW-5, GW-6, GW-7.GW-8, GW-9 and GW-10) have hardness value ranges as 112.0 to 288.0 mg/l respectively and are less than desirable limit of 300 mg/l as prescribed in IS 10500:1991

Health Related Parameters

- *Fluorides*

Fluoride concentration above 2.0 mg/l is harmful and can cause bone fluorosis. All ten ground water samples (GW – 1, GW – 2 GW-3, GW-4, GW-5, GW-6, GW-7.GW-8, GW-9 and GW-10) have fluoride content as 0.19 to 0.62 mg/l respectively which are lower than desirable limit of 1.0 mg/l as given in IS 10500:199

- *Nitrate*

Nitrate value should not cross the desirable limit as it can cause a serious disease in human being known as Methaemoglobinemia. Nitrate is usually contributed by excessive use of fertilizer and / or explosives and occasionally from minerals of the strata.

All ten ground water samples (GW – 1, GW – 2 GW-3, GW-4, GW-5, GW-6, GW-7.GW-8, GW-9 and GW-10) have nitrate concentrations 13.1, 14.1, 9.1, 12.0, 7.8, 13.1, 16.1, 9.1, 12.7 and 7.8 mg/l respectively, and much below the desirable limit of 45 mg/l.

- *Iron*

Beyond the desirable limit, Iron affects the taste and odour of water and promotes iron bacteria. All ten ground water samples (GW – 1, GW – 2 GW-3, GW-4, GW-5, GW-6, GW-7.GW-8, GW-9 and GW-10) have Iron content as 0.07, 0.097, 0.076, 0.068, 0.21, 0.208, 0.185, 0.083, 0.073 and 0.159 mg/l respectively. Iron values in all water samples are less than permissible limit of 1.0 mg/l.

- *Heavy Metals*

Heavy metals produce astringent taste if its concentration crosses the desirable limits. In alkaline water, metal concentration can be present in the form of hydroxides, most of which are insoluble. Heavy metals like Copper, Zinc, Manganese, Aluminum, Boron and other trace elements in all water samples are either absent or wherever present, were below their respective permissible limits.

Presence of toxic metals beyond desirable limits makes the water toxic and such waters are hazardous for health of human being. Toxic heavy metals like Cadmium, Lead, Arsenic, Hexavalent Chromium, Mercury etc were either below their respective

detectable levels or wherever present were below or equal to the permissible limits.¹⁰

- *Total Coliform*

The purpose of the total coliform counts in water bodies was to estimate the number of coliforms in water samples as an index of magnitude of biological contamination. Total coliform counts in water bodies are an important parameter for checking possible sewage contamination.

The presence of coliform organism are taken as indication that pathogenic organism may also present and absence of coliform organism is taken as an indication that water is free from diseases producing organisms.

All ground water samples (GW – 1, GW – 2, GW-3, GW-5, GW-6, GW-7, GW-8, and GW-10) have the load of total coliform and coliform 0.0 MPN/100ml, whereas the GW-4 and GW-9 have the highest load of 1.0 coliform /100ml.

- *Oil and Grease*

The purpose of oil & grease finding in this present study, percolation of oil into ground water from any activities like seepage and leachates of the depot plant during plant operation. All ten ground water samples (GW – 1, GW – 2, GW-3, GW-4, GW-5, GW-6, GW-7, GW-8, GW-9 and GW-10) have O&G content as 0.18, 0.12, 0.14, 0.12, 0.14, 0.11, 0.13, 0.14, 0.10 and 0.08 mg/l respectively. O&G values in all water samples are less than permissible limit of 0.3 mg/l¹¹

IV. CONCLUSION

Overall quality of water samples are showing that the water sources of the area are not polluted except the GW-4 and GW-9 water samples getting contamination from surface run-off or domestic uses. The coliforms values are exception otherwise all the water samples are indicating its characteristics within limit as given in relevant Indian Standards. The present study found that, there is no any percolation of oil, spillage of oils, etc into ground water quality in and around i.e. core zone of 3 km radius of oil refinery.

The finding of values of average oil & grease are 0.11 mg/lit at different places of 3km radius and concentration of oil & grease 0.18 mg/lit within premises of oil refineries.

All the calculated ground water quality parameters in studied lakes showed fair water quality rating in autumn season which then change to medium in winter seasons and higher during rainy seasons. The situation is alarming and degradation is in continues process, therefore in future the preventive action is required for its better water quality management and oil spillage contamination in ground water quality¹²

REFERENCE

- [1] Pandey, Sandeep K, and Tiwari, S., Physico-chemical analyses of ground water of selected area of Ghazipur city-A case study. *Nature and Science*. 7(1) (2009).
- [2] Environment Health Criteria, World Health Organization, Under IPCS. Geneva, 202(1998).
- [3] Jinwal, A, and Dixit, S. Pre and post monsoon variation in physico-chemical characteristic in groundwater quality in Bhopal, India. *Asian j. Exp. Sci*. 22 (3) (2008).
- [4] Kim, K., Rajmohan, N., Kim, H.J., Hwang, G.S. and Cho, M.J., Assessment of groundwater chemistry in a coastal region (Kunsan, Korea) having complex contaminant sources: A stoichiometric approach. *Environ. Geol.*, 46. 763-774. (2004).
- [5] APHA standard methods for examination of water and waste water, American Public health Association, Washington D.C. (1998).
- [6] Trivedi, P.K. and Goel, P.K., Chemical and biological methods for water pollution studies, Env. Publication, Karad (1986).
- [7] Jalali, M., Nitrates leaching from agricultural land in Hamadan, western Iran. *Agriculture, Ecosystems & Environment*, 110 210-218 (2005).
- [8] Rajdeep Kaur and R.V. Singh, 2011. Assessment for Different Groundwater Quality Parameters for Irrigation Purposes in Bikaner City, Rajasthan. Pacheco, J. and Cabrera, S., Groundwater contamination by nitrates in the Yucatan Peninsula. Mexico. *Hydrol. J.*, 5(2): 47-53. (1997).
- [9] Kumari Meena H.R. and Hosamani, S.P., Ground water classification of bore wells of Mysore city based on salinity hazard and sodium absorption ratio. *Nature, Environ. Pollut. Tech.*, 3, 359-364 (2004).
- [10] 10 Kumari Meena H.R. and Hosamani, S.P., Ground water classification of bore wells of Mysore city based on salinity hazard and sodium absorption ratio. *Nature, Environ. Pollut. Tech.*, 3, 359-364 (2004).
- [11] Rajesh, R. and Murthy, T.R.S., Ground water quality and its change over a decade: An analysis of a coastal urban environment from the west coast of India. *Environmental Geology*, 45, 978-981(2004).
- [12] Usha Madhuri, T., Srinivas, T., Jyothi, E. and Rani, Suneetha, Status of subsurface water quality in relation to some physico-chemical parameters- A study in Visakhapatnam. *Indian J. Environ. Hlth.*, 24, 11-13 (2004).